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ABSTRACT

This digest reviews some significant research on technology use in the classroom that examines how investment in technology will pay off in terms of student learning, and it indicates the conditions under which technology is most likely to have a positive impact on student learning. First presented are two longitudinal studies on how students learn from computers. It then discusses studies examining the effects of learning with computers, when technology is used as a tool rather than a tutor. Whether students learn from computers or with computers, the research cited indicates the following conditions under which computer technology is most likely to have a positive impact on learning.access; integration; broad-based reform; the long term; professional development; teaching style; balance; and vision. (Contains 13 references.) (AEF)

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Investing in Technology: The Payoff in Student Learning

By Harvey Barnett

Imagine this moment in your life as a school administrator. A skeptical school board member, prospective parent, or local public official visits your school and, after a tour in which you point out the wonderful new computers, scanners, digital cameras, and other technology which you've acquired over the past few years, says to you, "You've clearly made a tremendous investment in technology. How do you know this investment will pay off in terms of student learning?"

This ERIC Digest reviews some significant research on technology use in the classroom that attempts to answer this question and indicates the conditions under which technology is most likely to have a positive impact on student learning.

Research on the Use of Technology in the Classroom

Educational researchers have studied two major ways in which students use computers in schools. The first is learning *from* computers. Here the computer acts as tutor. The computer presents information to the student and the student responds. Simple drill and practice programs and more comprehensive Integrated Learning Systems, such as Jostens and Computer Curriculum Corporation, are examples of this category. Researchers have also focused on how students learn *with* computers. Here, students use computers and other technologies to write, analyze data, develop presentations, and do research.

Learning *from* Computers: Computers as Tutors

Let us look at two longitudinal studies on how students learn *from* computers. The first is the West Virginia Basic Skills study (Mann, Shakeshaft, Becker & Kottkamp, 1999; *West Virginia Study Results*, 1999).

West Virginia began implementing computer technology one grade at a time, starting with first grade. Each year the state added a grade until reaching Grade 6. Each year included extensive teacher training. Schools had the option of placing computers in classrooms or in a lab. Schools were also required to select from suites of software that matched West Virginia's content standards. Researchers followed students from first grade to sixth grade, and beyond. The researchers found the following when students used computers as tutors to receive information:

1. On statewide tests, students who learned from computers showed consistently higher gains. The researchers were able to determine that 11% of the gain was due to the use of technology.
2. Students did better when the computers were in the classroom rather than a lab.
3. The advantages of computer use extended through high school, where students learning from computers had better grades, took more advanced placement courses, and were more likely to graduate than those who did not use computers.

Another important study is Project CHILD from Florida (Butzin, 2000). Project CHILD placed computers in classrooms and, like the West Virginia project, provided extensive teacher training and had students use software that was aligned with the state's content standards. The Project CHILD researchers found that when students used computers as tutors to receive information

1. Computers contributed to higher scores for students in both low- and high-achieving schools
2. Students had better discipline
3. The boost that technology gave students was sustained over time, which was also the case in the study of computer use in West Virginia.

The studies in West Virginia and Florida show that students can gain an advantage when technology is deployed to bolster and complement the traditional work of teachers and that the effects of learning from computers are lasting. These results are obtained where there is on-going teacher training and where computers are available for use in the classroom.

Learning *with* Computers: Computers as Tools

What does the research say about the effects of technology when it is used as a tool rather than a tutor? How is learning *with* computers different from learning *from* computers? The application of technology here is even more powerful, as the following studies demonstrate.

In a study sponsored by Apple Computer that spanned ten years, researchers, who were from institutions of higher education and not Apple employees, analyzed Apple's Classrooms of Tomorrow project, known to many by the acronym ACOT (Fisher, Dwyer & Yocam, 1996; Sandholtz, Ringstaff & Dwyer, 1997). In ACOT classrooms, technology was pervasive and available anytime a student needed to write, analyze data, develop presentations, and do research. Teachers received intensive training and were given time to examine their beliefs about instruction and learning. Researchers arrived at four critical conclusions.

1. Students routinely used higher-order thinking skills far beyond what was expected for their grade level.
2. Students demonstrated enhanced ability to collaborate with peers to develop projects and reports.
3. Students demonstrated increased initiative. They maintained time on task for longer periods and often continued their work during recess, before school, and after school.
4. The use of technology coupled with teachers having time for reflection led, over a period of three to five years, to substantial changes in teacher beliefs about teaching and learning.

The ACOT findings are reinforced by a recent study of the Challenge 2000 Multimedia Project conducted by SRI International (Penuel, Golan, Means & Korbak, 2000). In the Multimedia Project, teams of K-12 teachers were trained to develop curriculum-based multimedia projects with students. The teachers received intensive on-site support.

In the final evaluation of the 5-year long project, the researchers asked students in project and non-project classrooms to complete an authentic assessment task. All students were given a set of resources and data about homeless students and the problems such students face in attending school. In small groups, students had to study the information, formulate a set of recommendations for their school leaders on how their own school might better serve the needs of homeless students, and create a prototype of a brochure for advocating their position. The brochures were evaluated using a rubric especially developed by SRI to help measure the impact of the use of technology.

What did SRI's researchers find? Students in Multimedia Project classrooms consistently out-scored their peers in the non-project classrooms in the areas of understanding content, adapting their message to their intended audience, and applying principles of design in the format and layout of their brochures.

Together, these studies point out how powerful technology can be when it is employed as a tool for research, data analysis, and communication. Does that mean we abandon the use of computers for simply acquiring specific facts and rudimentary skills? Of course not. We have to remember that it is never a question of either learning *with* computers or learning *from* them, but rather a balance between instruction and construction based on the objectives of the lesson.

Impact on Learning

Whether students learn from computers or with computers, the research cited above indicates the following conditions under which computer technology is most likely to have a positive impact on learning.

Access: Computers will enhance learning only when students have easy access to them *in their classroom*. Using computers once or twice a week will have negligible impact on student learning.

Integration: Computers make their greatest impact on student learning when their use is tightly linked to content standards and integrated into ongoing classroom work, rather than taught as a separate or stand-alone subject.

Broad-based reform: The computer is just one tool in a broad-based reform effort to improve student learning. Just as computer use needs to be integrated within the on-going instructional program, so technology planning needs to occur within the context of the entire school or district strategic planning process.

The long term: Like any other reform effort, computer use is not a one-time event. It is not simply a matter of "buy them, install them and sit back to enjoy the difference they make." It will require a long-term effort on the district's part to fund, support and assess their use.

Professional development: Having a swimming pool does little good if no one can swim, and learning to swim well is not done in a couple of after-school workshops. To empower teachers and students to learn *with* computers, districts will need to plan for ongoing staff development that takes place in large groups, one-on-one, and online.

Teaching style: For technology to have the impact research says it can, many teachers will have to learn more than new technology skills; they will need learn new instructional strategies and new roles. Districts will need to ensure that teachers have the opportunity and support to transform their approach to teaching.

Balance: Like any reform effort, one does not throw out the baby with the bath water. There is always a balance. Yes, teachers need to teach facts; but they also must help students acquire and use the intellectual and workplace skills demanded by the 21st Century.

Vision: As the research on effective principals demonstrates again and again, leadership is the single most important factor affecting the successful integration of technology in education. Principals and superintendents must have a vision of how technology will support student learning and teacher productivity.

Conclusion

The research reviewed in this ERIC Digest demonstrates that technology can make a difference in how and what students learn. Technology is one piece of the puzzle that can support educational change, but technology will have little impact without accompanying reform at the classroom, school, and district level.

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